NISTTech

Length Separation of Carbon Nanotubes by Centrifugation in a Dense Liquid

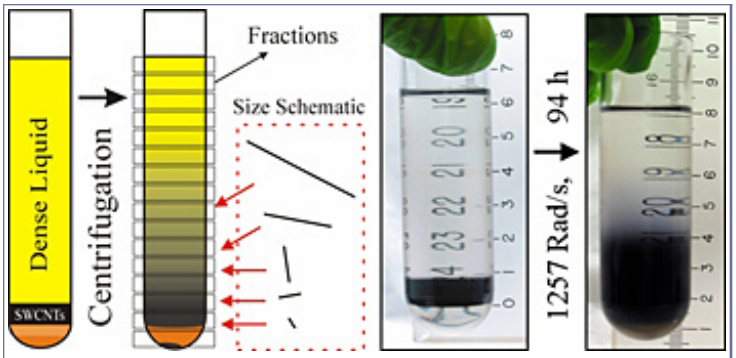
Economically sort carbon nanotubes into different sizes

Description

A method for length separation of single wall carbon nanotubes (SWCNT) using a high speed centrifuge to sort mixtures of nanotubes into different lengths. SWCNTs are rolled up sheets of graphite one atom thick and about a nanometer in diameter with remarkable features including extraordinary strength and unique electronic, optical, and mechanical properties. Worldwide demand for carbon nanotubes is growing rapidly with applications in fields including electrical, medical, and mechanical. Length separation provides for improved conductivity and percolating matrix networks, important advantages in many applications.

The method for manufacturing SWCNTs results in nanotubes of an enormous range of lengths, from a few tens or hundreds, up to thousand of nanometers. To effectively use carbon nanotubes for many potential applications, they need to be economically sorted by length. In biomedical applications, for example, it has been shown that whether or not nanotubes are taken up in the cell depends critically on length.

Images



The nanotubes start at the bottom of a dense fluid. When spun in a centrifuge, the nanotubes begin to migrate through the fluid driven by their buoyancy, but the longer ones move faster, spreading them out by length. Credit: NIST

Applications

- **Nanotube grade sorting**
  Allows the length-based sorting of all Single Wall Carbon Nanotubes

(SWCNTs)--crucial because long nanotubes possess better mechanical and optical properties.

Advantages

- **Inexpensive**
- **Larger quantities**
  Produces large quantities of SWCNTs, with a rate of 10 mg/day.
- **No auxiliary equipment**
  Does not require the purchase of additional equipment; utilizes centrifuges which are typically found in most laboratories.

Abstract

The invention is the exploitation of a difference in scaling with length of the hydrodynaiic drag on a nanotube, and the buoyancy force of the same nanotube to sort the nanotubes by their length. The buoyancy is generated by using a commercial density medium, a surfactant, such as sodium deoxycholate, that forms a miceller shell around the nanotube. The surfactat shell acts both to keep the nanotube individually dispersed, and as a buoyant volume with an effective density different from the surrounding medium.

Inventors

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Citations

1. 1.) J.A. Fagan, M.L. Becker, J. Chun and E.K. Hobbie. Length fractionation of carbon nanotubes using centrifugation. *Advanced Materials*. 2008. 20. 1609–1613.

Related Items

- Article: Spin Control- New Technique Sorts Nanotubes by Length

References

- U.S. Patent Application #20080290007
- Docket: 07-012

Status of Availability

This invention is available for licensing.

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